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**GRADUATE INSTRUCTION
IN AGRICULTURE
IN CANADA**

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GRADUATE INSTRUCTION IN AGRICULTURE IN CANADA

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A REPORT

Presented to the Ninth Annual Convention of
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FOREWORD

THE survey which provided the basis for the following report was carried out under the auspices of the Canadian Society of Technical Agriculturists through the financial support of the International Education Board, of New York. The original purpose, as set forth in the terms of reference, was to prepare a report which might serve as a guide to prospective graduate students in regard to opportunities for graduate studies in agriculture in the various Canadian institutions. It is hoped that this purpose may be served to some extent by the information contained in Part II. It seemed to the writer that a service equally important could be rendered by a discussion of the general problems in the development of graduate work in agriculture which were disclosed by the survey. The first part of the report is devoted to this, and it is hoped that it may be of some use to the administration of the institutions concerned in considering plans for the improvement and enlargement of their programmes.

The author has felt that the latter purpose could not be served without frank criticism, wherever such seemed to be called for. At the same time he wishes to be the first to point out the weaknesses inevitable in such a report as this, e.g.:

- (1) A visit of a few days at an institution is not enough to gain a complete understanding of local conditions and problems;
- (2) A report by a single observer is bound to be influenced by his personal leanings. Another observer might feel he had good reasons for writing a quite different report.

Time did not permit the carrying out of a survey as complete as originally intended. However, visits were made to all institutions actually carrying on graduate instruction in agriculture, and to various divisions of the Federal Department of Agriculture and certain other organizations. The lack of opportunity to visit the French-speaking agricultural colleges of Quebec is especially regretted, although these have not yet undertaken graduate work.

The author wishes to take this opportunity of thanking the administrative officers and members of the staff of the institutions visited, for the cordial welcome and assistance which he received everywhere. Full information in regard to research projects, courses, local plans and problems, was freely given to him.

NOTE.—Since writing this report there has come to the attention of the author the volume entitled, "Facilities for advanced study and research in agricultural science and cognate pure sciences in the United Kingdom", published by the British Ministry of Agriculture and Fisheries earlier in the present year. The latter volume was issued in accordance with a recommendation of the Imperial Agricultural Research Conference, 1927, which suggested also that uniform volumes should be prepared for the various other parts of the Empire. To avoid possible misunderstanding on the part of persons outside of Canada who may chance to see the present report, it should be explained that it takes its roots quite independently in a recommendation of the Committee on Graduate Studies to the annual convention of the Canadian Society of Technical Agriculturists in June, 1926 (*Scient. Agric.* vol. 6, p. 430-431, 1926). It is not intended to serve the purpose of the volumes contemplated by the Imperial Conference.—R.N.

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GRADUATE INSTRUCTION IN AGRICULTURE IN CANADA

R. NEWTON

Introduction

Graduate instruction in agriculture, or in one or more of its cognate sciences, is given at the Universities of McGill, Toronto (including the affiliated Ontario Agricultural College), Manitoba, Saskatchewan, Alberta and British Columbia. At the University of Manitoba, the work has not so far been organized through the College of Agriculture, but has been confined to other departments of the university. The degree of doctor of philosophy is offered by the first three of the above institutions. In the remaining three, only the master's degree is conferred, although some further work may be taken and credits transferred to other places.

Though the foregoing summary indicates that all the English-speaking Universities having faculties of agriculture as part of their organization now offer graduate instruction in agriculture, this advanced work is in most of these institutions still in a very young stage of development. The period which has elapsed since its inception in the different colleges, however, varies considerably. The Ontario Agricultural College, our oldest institution teaching agriculture, though it began its undergraduate instruction fifty-five years ago, has offered graduate courses only in the last two years. Macdonald College (McGill University), which dates back twenty-two years, began graduate instruction in a small way coincident with the graduation of its first class in 1911. This prompter beginning was no doubt owing in part to the closer association of Macdonald College with its parent university. The same comparative conditions may be observed in the western provinces. In Alberta, British Columbia and Saskatchewan, where the agricultural colleges are on the same campuses with, and form integral parts of the provincial universities, graduate work for the master's degree was developed as soon as agricultural graduates created a demand for it. In Manitoba, where the agricultural college was until recent years a separate institution, though a number of

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agricultural graduates have pursued higher studies in the university, no work of this kind has so far been organized by the agricultural college itself.

The separation of the first agricultural colleges from the universities created a situation which has been responsible for many of the problems in the development of graduate work in agriculture. Graduate instruction and graduate degrees carry the necessary implication of antecedent undergraduate instruction of university calibre. The founders of our first Canadian colleges had in mind vocational schools rather than universities, and established these institutions on farms widely removed from the universities. Primary emphasis was laid upon facilities for instruction in the practical art of farming, at whatever sacrifice of opportunity for scientific training and the broader culture of the university. Physical separation and different objectives had the unfortunate result of creating double standards, in regard to entrance requirements, course requirements for the degree and, worst of all, in the salaries and academic standing of the staff. Traditions of this sort, once established, were readily transplanted by staff and graduates when they migrated to man the newer institutions. Some of the agricultural colleges have not entirely outgrown these traditions yet, but fortunately all are now alive to the situation. Still harder to overcome than mistaken traditions is the permanent handicap imposed upon the older colleges by the physical distance which separates them from their parent universities. This is serious even from the undergraduate point of view, and much more so in regard to graduate work.

All the colleges have nevertheless established a creditable record of teaching, demonstration and experimental work. If there has been a weakness, it lies in the lack of proportionate contributions to new knowledge by fundamental research. There is, however, a vigorous stirring in the matter now clearly discernible. The important part which research must play in the development of the agricultural industry and in the solution of its many pressing problems is more and more appreciated both within and without the colleges. The growing popular interest in research has created an interest in the training of researchers. The time seems opportune therefore for a survey or general stocktaking of the problems of, and facilities for, graduate instruction in agriculture in this country.

PART I

GENERAL PROBLEMS

Men outside the faculties of agriculture, and some of those inside, were inclined to be critical of graduate work in agriculture under present conditions. An effort was made to determine the causes underlying this attitude, and the remedies which might be available. The more important conclusions are set forth in the following sections.

Standards of Entrance to Agricultural Colleges

In earlier days, the matriculation standard of entrance to agricultural colleges was not required. The inadequate preparation of the students had an important effect upon the curriculum, which naturally had to be kept within the range of their abilities. The graduates therefore were correspondingly ill-prepared for the prosecution of higher studies. The difficulties which they encountered in securing full graduate status in universities to which they went for further training had a reaction on their home institutions, and was one of the factors which forced a revision of entrance requirements.

In recent years all the colleges included in this survey have required university matriculation, or its approximate equivalent, as the standard of entrance to their degree courses. In two cases, Alberta and Manitoba, the ordinary matriculation is modified by omitting a language requirement. In Alberta, Macdonald College and the Ontario Agricultural College, provision is made for bridging over from diploma courses, which may be entered without matriculation, to degree courses, without loss of credit for work already covered, provided matriculation deficiencies are made up. In Alberta, the Olds School of Agriculture puts on a special matriculation year for students who have taken the two-year diploma course and wish to prepare themselves to complete the degree course in three more years' work at the University. At the Ontario Agricultural College, an intermediate year of purely academic work is put on for the same purpose after the completion

of the two-year diploma course and before entering upon the last two years of the degree course.

While some sort of effort is made at most places to accommodate deserving students, the trend is towards a stiffening of entrance requirements to the point at which they provide a proper basis for undergraduate work of university standard. With minor exceptions, therefore, the agricultural colleges may be deemed to have removed this ground of prejudice against their graduates.

The Undergraduate Curriculum

With entrance requirements such as to provide adequate preparation for university work, the next problem has been to evolve a satisfactory undergraduate curriculum. Here progress has been relatively slower. In all the universities visited, one of the main criticisms by men outside the agricultural faculties in regard to graduate instruction in agriculture was based on alleged inadequate preparation of the students.

The first agricultural colleges were really technical schools, where the emphasis was laid upon so-called practical instruction. An attempt was made to teach the students how to farm. The courses were as varied as the wide-spread interests of the farm, and it was not unusual for a student, to carry a dozen or more subjects in a single year.

Quite early there developed the plan of having two stopping places in the course: at the end of the second year, when a diploma was given to successful students, and at the end of the fourth year, when the degree was awarded. The diploma was intended particularly for students who were returning to the farm; therefore, as much practical work as possible was crowded into the first two years, and most of the science courses as well as the specialized work in the practical subjects left to the third and fourth years.

The realization gradually developed that such an arrangement was unsuitable for degree students, and did not fulfil the functions of a university course. The postponement of instruction in the fundamental sciences to the senior years was a reversal of accepted pedagogical procedure, and prevented the advancement of students in scientific training to a point comparable with that attained by graduates of other faculties.

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The next step was the separation of the diploma and degree courses. This seemed to clear the way for the development of a sound curriculum for the degree. The idea persisted, however, that no student should obtain a degree in agriculture without having studied a little of everything pertaining to the farm, and that he should obtain this general acquaintance with the whole field before being allowed to specialize in any particular branch. The result was that the curriculum of the first two years was so crowded with short courses in animal husbandry, poultry, dairying, field husbandry, horticulture, farm mechanics, etc., as to preclude the possibility of laying a proper foundation in science.

The colleges are still wrestling with this problem, and agricultural graduates still commonly find themselves handicapped in regard to their state of advancement upon entering graduate work. A member of the staff of one of the eastern institutions remarked that if agricultural graduates are required to have the same matriculation standing and take the same length of course as students in other faculties, it is an injustice to them to finish about one to one and a half years behind in actual training for scientific work. This handicaps them not only in entering upon graduate courses, but also in obtaining scientific positions. Some of the students themselves have realized this handicap early in their undergraduate career. At one of the western institutions, until options in chemistry and biology were added recently to the groups of senior courses in agriculture, a number of students who were planning to follow up agricultural investigation changed over from agriculture to arts to get better opportunity for undergraduate preparation in these subjects.

The diversity of interest and purpose of the students in a faculty of agriculture is of course a complicating factor in devising a curriculum which will be satisfactory to all. At the two extremes we have the students who are planning to return to the farm and those who are planning to follow a research career. Of course, very few of the latter sort will know their minds definitely at the outset, and it is not desirable to guide into such a channel those who lack native aptitude, since true researchers must be born before they are trained. But opportunity for the evolution of this type of mind is required at least as importantly as for the development of broadly cultured and scientifically trained farmers.

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Naturally in a report on graduate instruction it is the interests of the potential investigators which must receive primary consideration.

But the interests of the two groups are not irreconcilable. We can surely assume that when a student comes to a university to take a degree course in agriculture he wants something more than can be obtained in a technical school of agriculture, or in the corresponding diploma courses which are frankly technical in their character though accommodated in the university as a matter of convenience. The granting of a university degree in an applied science such as agriculture surely implies that the candidate has a sound knowledge of the scientific background of the subject. This sort of grounding, which should be emphasized particularly in the first two years of the course, is suited to all classes of students. In the latter part of the course, the student who by this time has developed a taste and shown an aptitude for the further pursuit of science should go more deeply into that side of the question, while his practically inclined fellows follow the more technical phases of agriculture.

The diversity of interests among agricultural students is really no greater than is found in the faculty of arts and science, or even in medicine, with its modern trend towards narrow specialization. There is considerable similarity between agriculture and medicine in regard to the preliminary preparation required by students. Both faculties are concerned eventually with the problems of living organisms, in health and disease. Medical students now almost everywhere take a pre-medical course of general training in science. This is often taken in the faculty of arts and science, and developed along the lines of an honours course in biology or chemistry. Such a course would be ideal for agricultural students.

In the past, indeed, many distinguished agricultural investigators have come up through pure science channels, without any subsequent formal instruction in agriculture. It seems very probable that a survey would show greater fundamental contributions to have been made to the progress of agriculture by non-agricultural graduates than can yet be attributed to graduates of agricultural colleges. To appreciate the force of this suggestion

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one has only to call to mind such names as Liebig, Davy, Lawes and Gilbert, Pasteur, Hellriegel and Wilfarth, Winogradski, Russell, Saunders and Morgan.

The agricultural colleges are still young, and in course of time will doubtless add their quota of names to the agricultural Pantheon. Some few names have already a fair title to fame. It remains true, however, that our colleges have not so far catered especially to the training of investigators. The foundations of this should be laid in the first years of the undergraduate course.

In medicine, competition has forced the lengthening of the course for both practitioner and investigator to a point beyond that which seems practicable in agriculture at present. A combined course in arts and agriculture has been offered in some institutions, but has not achieved much popularity. There was formerly at Toronto and there is still at McGill an arrangement making it possible for a student to take the first two years of his course in the faculty of arts and the last two years in the agricultural college. This scheme was intended primarily for the training of high-school teachers competent to teach agriculture, though any student might avail himself of it. On account of the wide physical separation of the colleges of agriculture at these two institutions, however, one could scarcely expect much community of interest between the students of the two faculties, or that there would be much "crossing over" of the kind indicated. Such a scheme would have more chance of success where all faculties are on the same campus, and several persons expressed themselves in favour of an experiment of this sort. Some were emphatic that the graduate from such a course would be much better prepared for higher training than the present agricultural graduate.

The main problem, however, is the development of a satisfactory pre-agricultural course in the agricultural college itself, as an integral part of the whole four-year curriculum. The criticisms encountered in regard to the inadequate preparation of graduates for higher training related principally to mathematics, physics, chemistry and languages. Two main reasons were assigned for the deficiencies in the fundamental sciences: (1) that the thoroughness of the first two years' work was prejudiced by sandwiching in a lot of short courses in the so-called practical agricul-

tural subjects; (2) that specialization began too soon; for example, in chemistry the student's attention was directed to soils and fertilizers, nutrition, etc., before he had a sound knowledge of inorganic, organic and physical chemistry.

All the colleges now accept the theory that the first two years should be devoted mainly to laying a foundation in science. The degree to which this is carried out in practice, however, varies considerably. There seems to be also a difference of opinion as to what is properly included in the term "fundamental science". With mathematics, physics and chemistry most persons would include botany and zoölogy, not a few would add bacteriology, and others would go so far as to include genetics, plant pathology, entomology and economics. This classification of the last four subjects at least, is quite unjustifiable, whatever other arguments may be adduced for including them among the courses of the first two years.

As a matter of convenience we may classify mathematics, physics, chemistry, botany and zoölogy as the sciences fundamental to agriculture. Excluding languages, all other subjects on the curriculum (including the applied phases of the foregoing) may then be classified as professional. On this basis, an examination of the calendars of the six agricultural colleges surveyed shows that on the average the time in the first two years now devoted to professional subjects is not far short of that devoted to the fundamental sciences. This does not mean necessarily that the number of hours devoted to the basic subjects is less than in the case of a student taking a science course in another faculty. The main criticisms, as noted above, arise from other causes.

One college, however, omits mathematics and physics entirely from the curriculum of the first two years, listing these subjects only as electives in the third and fourth years. Such an omission can scarcely fail to handicap the student in getting the most from his undergraduate professional courses and to restrict severely the scope of the post-graduate work open to him.

The deficiency of graduates in fundamental scientific training led one professor to remark, "They don't know the language of science." Mathematics as a vehicle for the exact expression of relationships is becoming more and more important and is more

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and more commonly used in biological research. It is literally true that much of the best literature in this field is closed to the student who lacks mathematical training.

The same is of course true of the student who reads only his own language. On the other hand, a knowledge of English, French and German opens to him at least in part the bulk of the scientific literature of the world. The practice is becoming increasingly common of adding a summary in one of these languages to papers written in other languages. The importance of English, French and German to scientific workers has led to their general requirement for the Ph.D. degree. Unfortunately, students quite commonly enter upon their graduate work with no appreciable knowledge of any language but English. One prominent leader of graduate students remarked that he could not get really serious work out of his students till they had gotten their language examinations out of the way. He would go into the laboratory and find them "mugging up" German instead of getting on with their research.

The University of British Columbia is the only one among the six surveyed which requires a language course other than English in the curriculum of the first two years in agriculture. The Ontario Agricultural College has required such a course of students in the science options in both third and fourth years, and beginning with the session of 1929-30 proposes to require it of all students in those two years. The University of Alberta and the University of Saskatchewan include French and German among the elective subjects of the third and fourth years.

It is perhaps inadvisable to propose the general introduction of more than one required language course in each of the first two years, and there is general agreement that two courses in English should be the minimum requirement in that language. It seems important, however, that students taking major work in science should have a course in at least one other language before graduating.

The problem of over-crowding of the curriculum is of long standing. This has always stood in the way of introducing more fundamental science and language courses, and of securing freedom from the distraction of numerous small courses in a wide variety

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of subjects. It is therefore of the utmost interest to record the opinion of the head of a "practical" department in the Ontario Agricultural College, that if the students were well grounded in science before reaching his department he could afford to discard four-fifths of his lecture notes. He pointed out, however, that such a system would demand on the part of instructors in agricultural subjects academic qualifications which would enable them to treat their lecture material in a thoroughly scientific way.

Most colleges have experimented more or less with their curriculum, and there is a strong body of opinion that, regardless of what theory may indicate, in practice a time-table for the first two years which excludes direct reference to some phases of practical agriculture has not been a success. Four principal objections to such an arrangement have been made:

- (1) Some students drop out and return to the farm without completing the course. Their brief sojourn at college would mean much more to them if some agriculture were included in the first two years.
- (2) It reflects unfavourably upon the college if students who have attended a year or two, when they return to their communities fail to show any improved knowledge of the practical phases of agriculture.
- (3) The students' parents as well as the students themselves are disappointed and dissatisfied if the material taught does not have some immediate reference to agriculture.
- (4) The absence of agriculture in the first two years would tend to deflect students from the practical options of the senior years.

The first of these objections may be effectively answered by pointing out that the course should be planned on the assumption that students will finish it. It is unfair to penalize graduates for the benefit of those who drop out half-way. To do this would be to revert to the days when diploma and degree students were taught together.

The second and third objections are not so easily disposed of. If the proposal were widely adopted that the first two years' work should be taken in the faculty of arts, and the agricultural course begin with the third year, this would remove entirely from

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the faculty of agriculture the onus of showing practical results to the farming community for the pre-agricultural course. This is essentially what is done in medicine for a much longer preparatory course, and no one thinks of objecting. But unfortunately the reverence of the public for medicine as something beyond their ken has not been extended to professional agriculture, and the need of a preparatory scientific training is not yet so generally appreciated.

In regard to the fourth objection, this may not be an unmixed evil. Some of the so-called practical departments have not kept pace with the times in placing their work upon a thoroughly scientific basis. A little competition may be wholesome. There is no reason why agronomy, horticulture, animal husbandry and the rest may not be made just as attractive to the scientifically minded student as the more scientific-sounding phases of biology, or even as chemistry or physics. Furthermore, there is abundant evidence that the keenest demand for investigators is now in fields calling for high scientific training. "Where", asked the Dominion Chemist, "can I find a cereal chemist who can tackle colloidal problems?" The Dominion Animal Husbandman is in need of an animal geneticist and an expert in animal nutrition. The Wool Committee of the National Research Council has for months been looking for a well-trained animal geneticist. "We have serious problems in agriculture and we have money to tackle them", said the executive of another research organization, "but the first problem is to find qualified men." A position for a research agronomist was created in one of the colleges last year, and is still vacant. So the story goes in regard to the need for scientific investigators. On the other hand, one of the reasons given for the stationary condition, or even falling-off in some cases, of the registration in our agricultural colleges, is the lack of suitable openings for the present type of graduate. While it is not suggested that the demand for more scientifically trained graduates is indefinitely large, there seems to be justification at least for encouraging the development of a greater proportion of this class than we have at present.

It is admitted, however, that so long as the pre-agricultural course remains the responsibility of the faculty of agriculture itself, the problem also remains of relating this to practical agricul-

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ture in some way, with as little scathe as possible to the scientific foundation which is the chief end of that period. Too often this is attempted by the introduction of a lot of little courses, sometimes called survey or viewpoint courses in agriculture. By the scientific staff, at any rate, this system is universally condemned. The only other system which has been proposed is the use of one general orientation or survey course covering the whole field.

The general survey course appears to have achieved a fair measure of success where it has been properly organized and conducted. Usually a number of men coöperate in putting on successive portions of one continuous course, each portion representing a major division of the field, the whole arranged in logical order and carefully correlated. If the instructors act independently, and in the time allotted to them put on merely detached elementary courses in some restricted phases of their particular subjects, the course becomes a hodge-podge and ends in blank failure. The primary object of such a course is not to impart technical information, but to develop an understanding and appreciation of: (1) the outlook, scope and problems of the different branches of agriculture as taught and investigated in a university; (2) the inter-relations of the different branches; (3) and most importantly, the relation of the practical subjects to the fundamental sciences which are being emphasized at this stage in the student's training, and the scientific approach to the solution of practical problems.

A general agricultural course should take up topics in a logical order, e.g.; climate; soil; crops (field and horticultural); crop pests (weeds, insects, diseases); animal husbandry; animal diseases; poultry; dairying; agricultural engineering; economics. A single full-year course of this kind, involving three hours' lectures and three hours' laboratory work weekly, should replace the large number of short courses given in the first two years. If desired, the course may be divided into two, and spread over two years. An arrangement which helps to ensure harmony and continuity is to have the whole given by one man of broad interests, with whom the various departments coöperate by supplying material. However, the difficulty of getting a suitable man as lecturer is often very great. The next subdivision would be into two, with two men giving the work in animal and plant science

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respectively. It has been shown to be perfectly possible, however, for as many as five men to coöperate successfully in the actual lecturing, and this has the advantage of providing contacts with the heads of the various agricultural departments, thus overcoming one of the objections to the omission of professional courses from the curriculum of the first two years. The difficulties of organizing and presenting a general survey course successfully should not be minimized, but where they are fairly met such a course seems to provide a logical solution for the problem in hand.

Macdonald College is proposing to adopt next session a curriculum for the first two years which will enable students to pass between the faculty of arts and the faculty of agriculture without conditions. Only one course in agriculture is included. This is called a general orientation course, for which the curriculum committee suggests the following tentative outline of the content: a sketch of the development of Canadian agriculture; the relation of the various branches of agriculture to the industry as a whole; the types of agriculture followed in or advised for the various sections of the country, and how they are adapted to climate, soils, markets, etc.; the relation of the several sciences to agriculture. "Viewpoint" courses are to be abolished. This is a bold experiment, the outcome of which will be watched with the greatest interest.

Representatives of the Ontario Agricultural College who have given the question much thought would go even farther, in that they would practically eliminate specialized professional training from the undergraduate course or, alternatively, lengthen the course to five years with the fifth year devoted to the intensive study of one special branch of agriculture. The opinion was expressed that the agricultural work of the four-year course might safely be reduced to one laboratory course per year, in which students would learn how to "lead a horse", how to distinguish breeds of animals and varieties of grain, and similar practical points of which ignorance on the part of an agricultural graduate might reflect discredit on his college. The need for introducing a modicum of practical laboratory work of the foregoing sort will probably meet with general assent, even though it must be admitted that such subjects as stock and seed judging sit very uneasily in a university curriculum. This Guelph proposal has not yet reached

the stage of a definite plan. It is indicative, however, of a widespread growing conviction that a good general education with a solid training in fundamental principles is the prime object of an undergraduate course, and that special applications may be safely deferred either to post-graduate courses or to practical experience.

The Manitoba Agricultural College, in revising its curriculum a few years ago, introduced the terms "plant science" and "animal science" to describe certain options available to students in the senior years. This seems greatly preferable to designating options by the names of individual departments. If the implications of the Manitoba terms are realized, they should afford scope for developing a soundly educational course. Similarly, Macdonald College has made provision in its newly revised curriculum for a course in "general biology" in the senior years, which for most students seems preferable to narrower options.

Degrees

The degree of bachelor of science in agriculture is awarded by all the Canadian colleges on the satisfactory completion of the undergraduate course in agriculture. The abbreviated designation used by all but one of them is B.S.A. Alberta originally used this designation, but later changed it to B.Sc. This change coincided with the revision of the entrance requirements and curriculum, which made these comparable in standard to those of other faculties. The other agricultural colleges likewise revised their standards, but did not change the designation of the degree.

The point may appear to be of little significance, but has some importance in those institutions which insist upon the strict sequence of degrees. The B.S.A. then leads to the M.S.A., and the agricultural graduate may find closed to him courses listed in the calendar as leading to the M.Sc. There is still to be found also a tendency to regard the B.S.A. and M.S.A. as of lower standing than the B.Sc. and M.Sc. This is inherited from the days when the agricultural colleges were frankly trade schools, without university matriculation requirements or university standards of instruction. One professor proposed recently to safeguard the integrity of the older academic degrees by creating for agricultural graduates the new sequence: B.S.A., M.S.A., D.S.A. (the last instead of Ph.D.). It seems unfair to agricul-

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tural graduates, however, if they comply with university requirements, to attach to them a label which, rightly or wrongly, is regarded as of less merit than that borne by graduates of other faculties. But whether the same or different degrees are used, it is clear that the standard of agricultural instruction should be maintained at such a level as not to form a just basis of discrimination.

In regard to the sequence of degrees, and the "tagging" of the master's degree with some word or letter indicating the faculty or field of work, the University of Alberta some years ago made inquiry as to the practices in twenty leading universities of Canada, Great Britain and the United States. The majority were found not to insist upon strict sequence of degrees, and only three or four still used tags. The two questions are to some extent interdependent, as if the bachelor's degree is tagged (as in B.S.A.) and strict sequence is insisted upon, then the master's degree must also be tagged (M.S.A.); while on the other hand the untagged B.Sc. would lead to the untagged M.Sc. There seems to be no logical reason for tagging the M.Sc., unless we are also to tag the Ph.D. Institutions which use the B.S.A. and also insist upon strict sequence are therefore bound to end in inconsistency.

Staff Problems

There has not been as yet much progress towards the strengthening of staffs specifically for the purpose of graduate work. For the most part this must be carried as an extra burden by the members of the undergraduate teaching staff.

The actual number of teaching hours borne by the staff of an agricultural college is not usually heavy, but the instructors have as a rule quite large demands made upon their time for extension work. An experiment station is associated with each agricultural college, and farmers and the public generally look to the colleges for an information service. While there can be no question as to the value of this service, it places a burden upon the staff out of proportion to that carried by the staff of any other faculty.

It has been shown to be possible, with suitable organization, for one man to combine teaching and extension work, or teaching and research work, but only in rare cases can he carry all three lines of work successfully. A combination of teaching and

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research is of course the normal programme of a leader of graduate students. In a few cases, however, chiefly at the colleges separated some distance from the universities, men with the training and aptitude for leading graduate students were found to be carrying such heavy teaching schedules (twenty or more hours per week) as practically to preclude the carrying on of research during the session or the effective direction of graduate work.

Not all well-trained men have the aptitude for leading graduate students. This is a matter for faculty and departmental organization. Differences in training and aptitude should be frankly recognized in the division of responsibilities and opportunities. This, of course, is not easy. "Research" and "graduate instruction" are terms to conjure with, and it is not human nature to forego the highest places voluntarily. One dean remarked that the majority of those claiming to do research were merely "riding on the bandwagon of the few."

It was explained in the introduction to this report how physical separation from the universities and different objectives of the first agricultural colleges had the result of creating different standards in regard, among other things, to the salaries and academic standing of the staff. The colleges are now alive to this situation, but it naturally takes a long time to rectify it fully. The problem is more difficult in those colleges which are not on the same campuses with their parent universities, since double standards of salary are more persistent there, and high qualifications cannot be exacted without due compensation.

The remedy seems to lie in (1) setting high standards of both training and compensation for new appointments, (2) encouraging junior members of the staff to complete their training and making their advancement conditional upon this, and (3) giving senior members sabbatical leave or other suitable opportunity for advanced study. Most of the colleges are now making progress in all three of these directions.

Subjects for Graduate Work

There is a strong body of opinion that the so-called "practical" subjects of agronomy, animal husbandry, dairying, poultry, horticulture, etc., as taught at present in most institutions, are not suitable subjects for graduate instruction, at any rate beyond the

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master's degree, except as the work is carried through the fields of the allied or constituent sciences. "Agronomy" is simply a convenient term to describe the study of physics, chemistry, botany, etc., in relation to crop production. When treated in this way, it gives abundant scope for scientific study and investigation. The same analysis may be made of the other agricultural subjects when viewed from the standpoint of a university.

Animal husbandmen interviewed lamented the small amount of graduate work going on in their particular field, and the dearth of graduates with higher training. It was pointed out among other things that there was need for studies of experimental methods in animal husbandry, and that a study of this sort, with supporting courses in chemistry or economics, would make a suitable programme for the master's degree. It was agreed that for higher work the departmental staffs for the most part needed strengthening in animal nutrition, physiology and genetics, unless effective coöperation in these phases was available in other departments of the university. The need for more attention to animal pathology was also stressed. One specific suggestion along this line was that a bilingual veterinary school should be established at Macdonald College.

In regard to the general question of programmes for the doctorate in one of the "practical" branches of agriculture, such as those enumerated above, it seems that for the present the best policy is to select in the field of the desired practical department a thesis topic which can be treated in a thoroughly scientific way, and apart from this to have the student register for supporting courses in the appropriate science departments.

The Research Basis

A research programme actively under way is the only proper basis for the development of graduate instruction in any institution. To plan graduate courses in advance of research is to put the cart before the horse. Graduate students are attracted naturally by research, and an institution which has a constant output of first-rate scientific papers needs no other advertisement.

Similarly, a research project should be the pivot in the programme of the individual graduate student. It is important that the thesis should contain some element of genuine research,

or original contribution to knowledge, and not be merely a compilation of information or observations, or even the record of an experiment, however carefully conducted, without any attempt to establish a new generalization or principle. For example, a plant-breeding experiment which has as its object the production of a superior new variety, does not of itself form a satisfactory subject for a thesis, but if the student is able at the same time to establish the mode of origin or inheritance of certain characters not previously explained, this introduces a research element which satisfies our standard.

The term "experiment" may of course be used in the wider sense to include all scientific research, but unfortunately there is in the popular mind a confusion which often results in applying the term "research" to experiments of a type which does not justify it. It seems better, therefore, to make a convenient distinction by defining experiment as a test or trial to discover a fact, and research as an experimental inquiry to discover a generalization or principle. The two are of course interdependent. On the one hand, the practical value of research is seldom realized until its findings are experimentally applied, while on the other, experimentation would end in bankruptcy if its working capital were not renewed from time to time by the fruits of research.

It may seem to matter little in practice whether work is called research or experiment. Herein lies the danger, that experiment as defined above possesses the lure of quick returns, and to call it research may prejudice the chances of genuine research to get support. When research languishes, experimentation soon becomes superficial. Such a state of affairs is by no means unknown in the history of agricultural experiment stations. To develop an appreciation of the methods and aims of research is a cardinal part of the training of a graduate student, and this should be reflected in his thesis.

The courses of the graduate student should be grouped around his thesis project, selected to improve his capacity for carrying on the investigation and to give him a broad knowledge of the general field within which the project lies. The seminar or colloquium is an important feature of a graduate programme. In these classes each student in turn presents a critical review of the literature of

some topic, and measures his wits against his colleagues in the ensuing discussion. Some hold the view that the topic selected by or for a given student should be outside the field of his research work, thus making it a broadening influence. The writer's experience of this plan, however, is that it is likely to result in dull and lifeless sessions. When the student has a personal interest in the subject, both his paper and the discussion are more lively and profitable. There is the further advantage of choosing a topic related to the field of his investigational work, in that during his search of the literature he never loses the genuine feeling of research, and this is projected into the classroom when he presents his paper.

An atmosphere of research in the institution and department is of the greatest importance. A Canadian graduate who spent a year in post-graduate work in animal husbandry at the College of Agriculture, Ames, Iowa, said that the two things by which he profited most were (1) a spirit of live-stock work and (2) a lot of it going on.

Institutional Specialization

Staff, laboratory equipment and other facilities adequate for work leading to the doctorate are available only in a very few lines in a very few places. There seems no prospect that any one institution can hope to become in the near future adequately equipped in very many lines. It would scarcely be expedient to attempt to do so. Institutional specialization and coöperation form the logical answer to restricted facilities.

At the same time it is doubtful whether much could be accomplished by conference intended deliberately to divide up the field. Local interests and the leanings and aptitudes of individuals are the factors which usually bring about specialization. It seems natural that cereal research in its various aspects should be developed more intensively in the prairie provinces, while live-stock, dairying and poultry should be more strongly featured in the other provinces. Nevertheless, a strong man with a penchant for research may develop outstanding work in any line almost anywhere. Once an institution or an individual has established a reputation in a given field, unless it is a very large one, other institutions or individuals usually prefer to enter another field

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rather than compete in the first. Thus specialization comes about naturally.

Agricultural students going to Great Britain to study most often go to Rothamsted for soils, to Cambridge for cereal breeding, to Aberystwyth for grass and clover breeding, to East Malling for horticulture, to Edinburgh for animal breeding, to Aberdeen or Cambridge for animal nutrition, to Oxford for economics, and so on. This is natural recognition of the specialties for which these places have become known.

Already there are tendencies towards specialization observable in our Canadian institutions.* There will always of course be a certain amount of overlapping of research programmes. Much of this will have the nature of desirable replication rather than useless duplication. There is, however, one special point at which duplication has always seemed to the writer entirely indefensible. There seems to be no justification for granting large sums to the universities for experimental and research work in agriculture if these funds are expended on the same kind of work as is being done at the numerous branch farms of the Dominion Experimental Farms system. The universities with their laboratory facilities and other scientific resources ought to be able to devise a programme covering problems which are beyond the scope of the branch farms.

The far-reaching and complicated nature of many problems now pressing for solution is forcing the development of institutional projects which several departments coöperate to attack from different angles. A good example of this is the poultry nutrition work at the Ontario Agricultural College. Under the leadership of the Poultry Department, several men from different departments of the College and Toronto University are uniting their efforts to secure an answer to certain very important and baffling questions. Another example is the poultry parasite investigation at Macdonald College. The first report on this project was prepared by men from the three departments of Entomology and Zoölogy, Animal Pathology and Poultry. It is planned to extend these investigations to other domestic animals. Still another

*Notes on some of the special research under way at the various colleges are given in Part II of this report.

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example may be cited from British Columbia, where a number of departments have coöperated in laying down a project for the study of blood normals in healthy animals and variations therefrom caused by various factors.

The foregoing development is very encouraging. A frank recognition of the limitations of departments individually, and a resolute effort to overcome these by bringing to bear on carefully selected projects the whole resources of an institution, will go far to place research and graduate work on a sound basis.

Coöperation with Non-Collegiate Institutions

What has been said above in regard to ways of eeking out our slender resources for graduate training points to the importance of supplementing these also by taking advantage of the facilities offered by non-collegiate institutions. A survey of the field shows that these are very considerable. Non-collegiate institutions should not be expected to develop formal courses of instruction—this would be usurpation of the proper function of the universities—but research contacts of a proper kind would react to the benefit of all concerned.

The Federal Department of Agriculture is a very large organization, offering many opportunities for coöperation with the universities. The Director of the Dominion Experimental Farms, when asked the question, "Do you approve of graduate employees, either temporary or permanent, using results of experimental farm work for thesis purposes?" answered emphatically, "Yes." Special opportunities for collaboration are presented by the plant pathological laboratories established by the Experimental Farms Branch at the Universities of Manitoba, Saskatchewan and Alberta. Another opportunity for coöperation to mutual advantage was suggested by an official of the Experimental Farms as existing between the Central Farm and Macdonald College. Other branches of the Federal Department are also willing to coöperate. Within the last few years there have come to the writer's personal attention a number of cases in which successful candidates for the master's degree at the University of Alberta had carried out their investigational work in the Entomological Branch, the Seed Branch, or the Experimental Farms Branch.

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The National Research Council of Canada has for many years made substantial contributions to the advancement of graduate instruction, in two principal ways: (1) by scholarships, (2) by grants in aid of research in the universities. The first of these ways helped students directly. The second way helped them indirectly but not less importantly, by making it possible to expand existing university programmes of fundamental research, thus developing the environment necessary for graduate work. The Research Council has been successful also in promoting several large coördinated researches, in which several institutions, both collegiate and non-collegiate, have participated. Examples of these activities are the investigations of cereal rusts, of bovine tuberculosis and of the drying of wheat. These all contribute to the general research atmosphere in which graduate instruction flourishes, besides providing for graduate assistants work of a kind suitable for thesis purposes. It is expected that the new laboratories of the Research Council at Ottawa will be built and equipped on a generous scale, and manned by a staff competent and willing to direct the investigations of graduate students who may desire to take advantage for a time of these special facilities.

The provincial departments of agriculture are for the most part engaged in administrative, promotion or field work of a kind which presents few opportunities for investigations suitable for thesis purposes. The provinces, however, are one by one establishing special research organizations. The Alberta Research Council has been active for some ten years, and although it has devoted its attention mainly to research on coal and road materials, in recent years it has supported soil surveys and coöperated in wheat-drying investigations. The latter project has been the basis of a number of graduate theses. The Saskatchewan Agricultural Research Foundation was established three years ago to promote scientific research into agricultural problems and to provide scholarships for agricultural students, both undergraduate and graduate. This organization has already supported investigations on milling qualities in wheat, glume rot in wheat, and on dairy, poultry and marketing problems. About a year ago the Ontario Research Foundation came into being, with a substantial endowment, and is laying plans for a program which will include the investigation of agricultural problems. No doubt other provinces will follow suit, and as these provincial research organizations

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work mainly through the universities, the latter may expect increasing support from this source.

One other non-collegiate institution should be mentioned, namely, the Empire Marketing Board. This organization includes among its activities the making of grants for scientific research into problems of production and marketing. The grants are in many cases made conditional upon equal contributions by the institution benefitting. There are two important researches under way in Canada which receive help from this source, namely, the poultry nutrition studies at the Ontario Agricultural College and the cheese ripening studies at the University of British Columbia.

In advocating that we should make the fullest possible use of facilities for graduate instruction in non-collegiate institutions, it is not to be understood that the writer believes the benefits of such a policy to be all on the side of the colleges. Graduate students are the yeast which keeps a research institution fermenting. An institution which lacks the renewal of inspiration and enthusiasm provided by successive generations of keen students is very apt to get into ruts and end in dull routine. It is a sign of the times that the most respected agricultural research institutions, as for example the Rothamsted Experimental Station and the John Innes Horticultural Institution, have developed close associations with universities and carry graduate students. The incomplete success of some others may not unjustly be attributed to their lack of foresight in this direction.

The Outlook

In concluding this part of the report on graduate instruction in agriculture in Canada, it should be stated that, notwithstanding the problems which have been indicated and the criticisms which have been made, the writer is optimistic as to the outlook. Remedies for most of the difficulties lie in our own hands, and there is a disposition to apply them. Undergraduate curricula are being improved in the direction of providing a better basis for advanced studies and research. The training of the staff is also improving, and the need for providing leisure and opportunity for research is recognized.

While facilities in this country are thus developing, it must of course be frankly admitted that for some years to come it

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will be necessary for most of our students to go overseas or to the United States for most advantageous training for the doctorate. Indeed it will always be desirable that large numbers of students should go abroad, and bring back the leaven of new ideas and wider vision, but we may justly aspire to make this movement of students one of exchange and not merely of export. The day of national equality in higher learning may be hastened by coöperation between all institutions, collegiate and non-collegiate, doing research work in this country, and by a measure of institutional specialization.

PART II

SURVEY OF FACILITIES

The following notes are not intended to give complete information as to the facilities for graduate instruction in agriculture at the various institutions. The object is to give sufficient information in regard to degrees and courses available, the chief regulations pertaining thereto, and other features of probable interest to prospective graduate students, to help them in the choice of a suitable place in which to prosecute advanced studies. This is the principal advantage of bringing together in a single publication brief statements in regard to all the universities offering graduate work in agriculture.

When a student has selected an institution which appears to offer facilities in the line he wishes to follow, he should communicate directly with its administrative authorities and through them get in touch with the head of the department in which he desires to work. A copy of the university calendar and full particulars of the opportunities and requirements for advanced work should be obtained. It is especially desirable to ascertain in advance that any thesis project which the student has in mind is acceptable and also practicable of satisfactory completion in the time available and under the conditions obtaining at the institution concerned.

French-speaking Colleges

The French-speaking colleges at Oka and Ste. Anne de la Pocatière, which are affiliated respectively with the Universities of Montreal and Laval, have the matter of graduate work under consideration, but have not yet developed instructional work of this grade.

McGILL UNIVERSITY

The Faculty of Agriculture of McGill University is located at Macdonald College, some twenty miles from the main campus of the University. Undergraduate instruction is given entirely at Macdonald College, while graduate instruction is given in part on both campuses. Courses leading to higher degrees are directed by the Faculty of Graduate Studies and Research, which has two main divisions, dealing with arts and science respectively. Agricultural graduates come under the immediate jurisdiction of the Science Divisional Committee. Inquiries should be addressed to the Dean of the Faculty of Graduate Studies and Research, McGill University, Montreal, Quebec.

The advanced degrees offered include those of Master of Science, Master of Science in Agriculture, and Doctor of Philosophy. The following regulations for these degrees are taken from the 1929-30 calendar of the Faculty of Graduate Studies and Research. Subjects and clauses which appeared to the writer to be of no immediate interest to agricultural graduates are omitted.

Regulations for the Degree of Master of Science (M.Sc.) (McGill University)

Instruction in the Faculty of Graduate Studies and Research leading to the degree of Master of Science is provided in the following departments of study, which rank as "subjects":—

Bacteriology.	Geology and Mineralogy.
Biochemistry.	Mathematics.
Botany.	Physics.
Chemistry.	Physiology.
Chemistry, Agricultural.	Plant Pathology.
Entomology.	Zoölogy.

The requirements for the degree are as follows:—

1. Candidates must hold the degree of B.Sc. with at least second class Honours.
2. The course of study followed by the candidate shall be of an advanced character, being the equivalent of that required

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for the degree of M.A., and shall lie in the domain of pure or applied science. It may be selected from any one or (at the discretion of the Head of the Department in which the major subject is) two subjects included in the list given above. This course of study, which must be of a comprehensive character, must have been previously submitted to the Head of the Department and to the Divisional Committee concerned, and have received their approval in writing. The candidate shall pass an examination in each subject of his course.

3. The candidate shall also present a thesis on some subject connected with his course of study. The title of the thesis must have been previously submitted to the Head of the Department and to the Divisional Committee concerned, and have received their approval in writing. The thesis must be in some measure a contribution to knowledge and must also be written in good literary style.

4. The thesis must be in the hands of the Dean of the Faculty of Graduate Studies and Research on or before April 28th if the candidate wishes to present himself for the degree at the Convocation in May, except in the case of theses involving experimental work, when the time will be extended to May 12th. No thesis received after these dates will be accepted.

Theses for the Fall Convocation must be presented before September 3rd.

Regulations for the Degree of Master of Science in Agriculture (M.S.A.) (McGill University)

Instruction in the Faculty of Graduate Studies and Research, leading to the degree of M.S.A., is provided in the following departments of study at Macdonald College (Faculty of Agriculture):—

Agronomy.
Agricultural Bacteriology.
Agricultural Chemistry.
Entomology.
Plant Pathology.

The requirements for the degree are as follows:—

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1. Candidates for this degree must hold a B.S.A. degree with at least second rank Honours from McGill or its equivalent.

2. Candidates must take one year of resident graduate study at Macdonald College, Faculty of Agriculture, McGill University.

3. One or two subjects may be taken.

4. When two subjects are taken, one of them shall be designated as the major subject, and special attention shall be paid to it. It must be a subject which the candidate has already studied in his undergraduate course, and the work required in it will represent an attainment in knowledge far in advance of that required for the B.S.A. degree.

5. The course of study selected by the student must receive the approval, in writing, of the Heads of the Departments concerned and also of the Divisional Committee concerned.

6. The candidate shall also present a thesis on some topic connected with his major subject. The title of his thesis must have been previously submitted to the Divisional Committee concerned, and the Head of the Department concerned, and have received their approval in writing. The thesis must be in some measure a contribution to knowledge and must also be written in good literary style.

The thesis must be in the hands of the Dean of the Faculty of Graduate Studies and Research on or before April 28th if the candidate wishes to present himself for the degree at the Convocation in May. If the course involves laboratory work, the thesis must be submitted before May 12th.

7. Candidates for the M.S.A. degree who select Agronomy may register in September or January. In the latter case they will be expected to remain in residence until the end of September, and application must be made before February 1st. It is recommended that one Summer be spent in the Agronomy Department, before or during the course, to allow for practical, field, laboratory and thesis work during the growing season.

Regulations for the Degree of Doctor of Philosophy (Ph.D.) (McGill University)

1. Candidates for the degree of Doctor of Philosophy must hold the degree of B.A. with Honours, or B.Sc. with Honours, or

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B.S.A. with Honours, or M.D. with Honours from McGill University or its equivalent.

2. They must follow a course of at least three years' resident study at a University or other institution of higher learning or research. Of these three years, at least one year for graduates of McGill and two years for candidates who are not graduates of McGill, must be spent at this University, including preferably the final year. The other years may be spent at institutions approved by the Faculty. Special exceptions regarding resident study may be made with the consent of the proper Divisional Committee and the Faculty. The evaluation of work done in other institutions for the degree shall be decided by the proper committee of the Division of the Faculty, and this committee may require the student to attend before them to report on his work, and may require him to pass a special examination on his work.

3. They must select one major subject. A minor subject may be selected, with the consent and approval of the Head of the Department in which the major subject is, subject to the advice and agreement of the Head of the Minor Department.

Courses leading to the degree of Doctor of Philosophy are offered in the following as major subjects:—

Bacteriology.	Geology.
Biochemistry.	Physics.
Botany.	Physiology.
Chemistry.	Plant Pathology.
Economics and Political Science.	Zoölogy.

In special cases, Heads of Departments may be able to provide courses in other subjects which will lead to this degree. Candidates, therefore, desiring to proceed to the degree of Doctor of Philosophy in other Departments than those mentioned above should make direct application to the Faculty of Graduate Studies and Research, asking whether courses in such subjects can be provided.

4. The course of study which the candidate desires to follow must, before he enters upon it, have been submitted to the Heads of the several Departments concerned and to the Divisional Committee concerned, and have received their written approval.

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5. Every candidate must satisfy the Faculty of Graduate Studies and Research that he has a reading knowledge of French and German.

The examination shall be set by the Department in which the candidate is taking his major; the passages chosen will be typical of the literature of his major subject. The Departments of Romance and Germanic Languages will act as examiners. The Departments concerned may conduct the examination if they so desire.

Candidates are advised to take one language at the commencement of their first year and the other at the commencement of the second year, but both language tests should be passed not later than one month before the preliminary Ph.D. examination.

6. The first two years shall include instruction, training and direction in his field of study, with the object of giving the candidate a knowledge of his particular subject and its relation to cognate branches of learning and of preparing him for independent investigation.

The candidate's preliminary examination shall be held at the end of the second year, or at a time selected by the Head of the Major Department. This examination shall cover all graduate work previously taken by the candidate, including his prescribed reading, and may also include any work fundamental thereto. The candidate must show that he possesses a good general knowledge of the whole science or branch of learning which he has selected as his major subject. The examination shall be both written and oral.

The result of this examination will determine whether the candidate will be allowed to proceed to his degree. The final year is to be devoted chiefly to the preparation of his thesis or dissertation.

After his thesis has been received and approved, a special and more searching oral examination on the subject of his dissertation and subjects more intimately related to it will constitute his final examination. This will be conducted in the presence of a committee of at least four of the Faculty of Graduate Studies.

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7. The thesis for the Doctor's degree shall display original scholarship expressed in satisfactory literary form and be a distinct contribution to knowledge. The subject of this thesis must have been approved, in writing, by the Head of the Department in which the major subject lies, and also by the Faculty of Graduate Studies and Research, at least twelve months before the date of the final examination. If the candidate wishes to present himself for the degree at the Convocation in May, this thesis must be in the hands of the Dean of the Faculty of Graduate Studies and Research on or before April 28th. No thesis received after this date will be accepted.

Theses for the Fall Convocation must be in the hands of the Dean of the Faculty on or before September 3rd.

8. Three copies of the thesis must be provided by the candidate and delivered to the Dean of the Graduate Faculty at the dates mentioned in the former paragraph.

Graduate Courses Offered at Macdonald College

It will be noticed that Plant Pathology appears as a subject for all three graduate degrees for which the regulations are given above. Agricultural Chemistry and Entomology are listed for the the M.Sc. and M.S.A., while Agronomy and Agricultural Bacteriology are available for the M.S.A. only. These are the five departments offering graduate courses at Macdonald College. The courses offered are the following:

Agronomy.

- Crop production.
- Crop breeding.
- Experimentation.
- Forage crops.
- Grain crops.
- Seminar.

Agricultural Bacteriology.

- Soil microbiology.
- Pathogenic microbiology.
- Bacterial diseases of plants.

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Plant Pathology.

- History of plant pathology.
- Advanced mycology.
- Advanced plant pathology.
- Physiology of the fungi.
- Phytopathological histology.
- Cytology of the fungi.
- Seminar.

Agricultural Chemistry.

- Chemistry of soils and fertilizers.
- General biochemistry.
- Chemistry of insecticides and fungicides.
- Dairy chemistry.
- Food chemistry.
- Tutorial in physical chemistry.
- Tutorial in organic chemistry.
- Tutorial in colloid chemistry.
- Seminar.

Entomology.

- Taxonomy.
- Insect morphology and physiology.
- Economic entomology.
- Parasitology.
- Medical and veterinary entomology.
- Ecology.
- Seminar.

The courses in bacteriology and chemistry shown above are supported and extended by courses in the same subjects available on the main campus of McGill University. General bacteriology and dairy bacteriology may be taken most advantageously on the main campus. In addition there are good facilities on the main campus for advanced studies in other cognate sciences included in the lists of subjects for the M.Sc. and Ph.D.

Special Research at Macdonald College

An institutional project for the study of the internal parasites of farm animals is well under way. The work was begun with poultry, and is now being extended to swine and sheep. The departments coöperating include animal husbandry, poultry, entomology and zoölogy, and animal pathology. Coöperation with the department of chemistry is also proposed, in connection with nutritional studies.

The Department of Animal Pathology is also investigating contagious abortion in cattle.

A soils research committee has been formed to promote coöperative investigations by the departments of physics, chemistry, agronomy, bacteriology and plant pathology. The causes for the unproductivity of certain Quebec soils are being studied.

The foregoing investigations present good opportunities to graduate students in parasitology and soil chemistry.

Reference should be made also to the long-continued investigations of maple sugar and syrup, in the Department of Agricultural Chemistry, in which the problems of a local industry have been followed up with commendable persistence. These investigations have received some assistance from the National Research Council, and are still in progress, usually furnishing employment and thesis material for one graduate assistant each year.

Reference has already been made to the special opportunities for work in certain phases of agricultural bacteriology, especially dairy bacteriology, on the main campus of McGill University.

Ontario Agricultural College University of Toronto

The Ontario Agricultural College at Guelph, some fifty miles from Toronto, is affiliated with the University of Toronto. Graduate work in the University is directed by the Council of the School of Graduate Studies. For the immediate supervision of the work in agriculture, however, there is a special Joint Committee from the University and the Agricultural College. The work may be carried on at either or both institutions, as arranged with the Committee. Information regarding the courses may be obtained from the Secretary, School of Graduate Studies, University of Toronto, Toronto.

The degrees of Master of Science in Agriculture (M.S.A.) and Doctor of Philosophy (Ph.D.) are offered. The following regulations are taken from the 1928-29 calendar of the School of Graduate Studies.

Regulations for the Degree of Master of Science in Agriculture. (University of Toronto)

1. Candidates eligible for the degree must have received the degree of Bachelor of Science in Agriculture from the University of Toronto or must possess equivalent qualifications.
2. Application for registration as a candidate for the degree must be made to the Secretary of the School of Graduate Studies not later than the 5th of October in any year, and the application must be accompanied by statements of the applicant's degrees, of the courses pursued as an undergraduate and his standing therein and of the course or courses of study he wishes to pursue.
3. A candidate will be required to spend not less than one academic year in study and research and must submit a thesis which shall be an original contribution to scientific knowledge. He must possess a reading knowledge of at least one foreign language and he must satisfactorily undergo an examination in the subject in which his thesis lies, together with such other examinations as may be required. Three printed or typewritten

copies of the thesis submitted must be presented to the Secretary of the School of Graduate Studies not later than the 1st of May, but an earlier date may be determined by the departments concerned.

4. The supervision of the candidate's work and the conduct of the required examination shall be by a department or departments of the University of Toronto in collaboration with a department or departments of the Ontario Agricultural College.

***Regulations for the Degree of Doctor of Philosophy.
(University of Toronto)***

1. The candidate shall, as a registered graduate student, have pursued in this University for at least three years, under the direction of some one department, an advanced course of study, which must be approved by the committee administering the regulations governing the degree of Doctor of Philosophy. Exemption from one of the three years required may be granted by the committee, on the report of the department concerned, to a candidate who has furnished satisfactory evidence of having pursued for at least one year a course of advanced study in his major subject at another University, or who, at graduation as Bachelor of Arts in this University, has obtained first class honours in a special course, covering one year of advanced study approved by the committee.

It must be clearly understood, however, that the degree is granted only to such students as give evidence of general proficiency, power of investigation and high attainments in the special field in which the major work is done.

2. A statement of the course of study proposed must be sent to the Secretary of the School of Graduate Studies not later than the 1st of November of the first year of registration, and must be accompanied by the approval of the departments concerned.

3. The course shall include the study of a special subject, termed the major subject, and of two other subjects, termed the minor subjects. Only one minor subject shall be selected from the group of subjects of the department which includes the major subject. The time required for the two minor subjects should not exceed two-thirds of that required for the major subject.

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4. The candidate must have an adequate knowledge of French and German. In special cases the substitution of another foreign language for one of these will be permitted. In some departments a knowledge of Latin is also essential.

5. The candidate shall present, either during his course of study or at the completion of it, a thesis embodying the results of an original investigation, conducted by himself, on some approved topic selected from his major subject.

6. The acceptance of the thesis shall be determined by the committee administering the regulations governing the degree of Doctor of Philosophy on the report of the department which includes the major subject. This report shall state, in terms to be approved by the Council, whether the thesis complies with the conditions prescribed by this University, and, in the judgment of the department, is worthy of publication, as defined in section 9 and whether the department recommends that the thesis be accepted in conformity with the requirements for the degree of Doctor of Philosophy.

The work upon which the thesis is based must be carried on under the direction of a member of the University staff and in the case of qualified students may, with the approval of the Council of the School of Graduate Studies, be carried on at an affiliated College of the University.

7. The candidate shall undergo examinations in his major and minor subjects conducted by the departments in which he is enrolled. The departments shall be responsible to the Council for the conduct of these examinations, and when the candidate shall have fulfilled all the requirements of the departments concerned in respect of the major and minor subjects and the thesis shall have been recommended for acceptance in accordance with regulations 5 and 6, the departments in which the candidate is registered shall so report to the Council.

8. When the departmental reports called for in regulations 6 and 7 shall have been received and the Committee administering the regulations governing the degree of Doctor of Philosophy shall have accepted the thesis, the candidate shall be required to give an exposition of his thesis and to defend it before a specially appointed committee of the Council.

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All members of the Council shall have the right to be present at this examination and to take part in it. The special committee to which the conduct of this examination is assigned shall be appointed by the Dean of the School of Graduate Studies in consultation with the Head of the Department in which the candidate has taken his major subject. At least one member of the committee shall be appointed from a department other than those in which the candidate has taken his major and minor subjects. The committee, through the Dean or his representative, shall report the result of the examination to the Council.

9. Before the degree is awarded the candidate must deposit with the Secretary of the School of Graduate Studies two printed or typewritten copies of his complete thesis, and furthermore he must, subject to the approval of the committee administering the regulations governing the degree of Doctor of Philosophy, make such arrangements as will ensure the publication of the thesis either as a whole or in an abstract approved by the committee. Such abstract shall consist of not less than twelve hundred words. On its title page each printed or typewritten copy of the thesis shall have the words "A Thesis submitted in conformity with the requirements for the degree of Doctor of Philosophy in the University of Toronto", and in the case of abstracts the words "Abstract of a Thesis submitted in conformity with the requirements for the degree of Doctor of Philosophy in the University of Toronto."

10. On the report of the Council of the School of Graduate Studies that all the requirements have been complied with, the Senate may, either at a Convocation or at any one of its regular meetings, confer on the candidate the degree of Doctor of Philosophy.

Graduate Courses Offered at the Ontario Agricultural College

(From leaflet enclosed in Calendar of the School of Graduate Studies, 1928-29).

Graduate students in agriculture may select courses from various departments of the School of Graduate Studies (University of Toronto) in addition to those listed below. Requirements

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to be made of individual students will be determined by the department or departments concerned and will include the necessary training in fundamental sciences.

In the following list the "majors" are subjects in which the candidate may conduct his research; the "minors" are those in which additional instruction is offered. A minor for a Ph.D. degree may include more than one subject.

Agricultural Economics.

Majors—Agricultural economics.

Farm organization.

Marketing farm products.

Poultry marketing (offered in collaboration with the Department of Poultry Husbandry).

Minors—Are available in the above mentioned subjects, and also in:

Economic theory.

Statistical methods.

Agricultural Engineering.

No majors are offered at present but the resources of the Department are available for graduate students as those in charge of their work may require.

Minors—Heat.

Light.

Mechanics.

Electricity.

Drainage and surveying.

Climatology.

Cold storage and ventilation.

Farm implements and machinery.

Mathematics of statistics.

Agronomy.

Majors—Crop production.

Plant breeding.

(a) Cereal crops.

(b) Forage crops.

Crop ecology.

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Minors—Cereals.

Forage crops.

Roots and fodder crops.

Crop ecology.

Agricultural organization (agronomy.)

Seed judging.

Animal Husbandry.

Majors—Applied animal nutrition.

Animal production.

Animal breeding.

Meats.

Minors—Stock judging.

Herd book studies.

Markets and market classes.

Carcass work.

Apiculture.

Major—Apiary management.

Minors—Apiary management.

History of apiculture.

Marketing honey.

Apiary products.

Bacteriology.

Major—Dairy bacteriology.

Minors—Cultural and microscopical methods.

Bacteriology of the soil.

Dairy bacteriology.

Microbiology of fermentations and foods.

Sanitation and hygiene bacteriology.

Household science microbiology.

Pathological bacteriology.

Bacterial diseases of plants.

Botany.

Majors—Plant pathology.

Systematic botany.

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Minors—Are available in the above mentioned subjects, and also in:

Plant physiology.
Plant histology and cytology.
Cryptogamic botany.

Chemistry.

Major—Soil chemistry.

Minors—Biochemistry.
Animal nutrition.
Dairy chemistry.
Insecticides and fungicides.
Soil technology.

Dairying.

Majors—Milk technology.
Market milk.
Manufacture of ice cream and ices.
Manufacture of butter.
Manufacture of cheese.

Minors—Are available in the above mentioned subjects and also in:

Manufacture of soft and fancy cheese.
Testing and inspection of milk and milk products.
Judging of dairy products.

Entomology and Zoölogy.

Majors—Economic entomology.
Insect morphology.
Systematic entomology.

Minors—Are available in the above mentioned subjects and also in:

Vertebrate histology.
Vertebrate embryology.
Invertebrate zoölogy.
Vertebrate zoölogy.

Genetics.

Majors and Minors in plant and animal genetics.

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The Professor of Genetics will collaborate with other departments in the direction of major work in special fields of genetics.

Horticulture.

No majors are offered at present but the resources of the Department are available for graduate students as those in charge of their work may require.

Minors—Methods and practices of propagation.

Systematic pomology.

Landscape gardening.

Seminar course on investigations and problems.

Fruit-growing.

Vegetable-growing.

Floriculture.

Poultry Husbandry.

Majors—Poultry production and management.

Poultry marketing.

(Offered in collaboration with the Department of Agricultural Economics.)

Poultry genetics.

Poultry nutrition.

Minors—Poultry production and management.

Poultry marketing.

Special Research at the Ontario Agricultural College

The poultry nutrition studies, which are being assisted by a grant from the Empire Marketing Board, are the most striking features of the research program at Guelph. The problem of the hatchability of eggs is being attacked from several angles: biochemistry, embryology, histology and genetics. These studies have acted as a stimulant to interest in agricultural research in the University of Toronto as well as in the College itself. They present first-rate opportunities to graduate students.

The Department of Chemistry is making a special study of soil survey methods and problems. It has also special facilities for the study of bread-making problems by reason of the associated Trent Institute of Baking, which is built on the College campus and directed by the head of the Chemistry Department.

University of Manitoba

The Manitoba Agricultural College is a part of the University of Manitoba, though some six miles removed from the main university campus. No graduate instruction has so far been offered on the agricultural campus, but a number of agricultural graduates have pursued higher studies in the University. The degrees of Master of Science and, with certain restrictions, Doctor of Philosophy are obtainable. Inquiries may be addressed to the Secretary, Committee on Post-Graduate Studies, University of Manitoba, Winnipeg.

Regulations for the Degree of Master of Science

(From Arts and Science Calendar, University of Manitoba, 1928-29).

1. To be accepted as a candidate for the degree of Master of Science an applicant must hold the degree of Bachelor of Science of the University of Manitoba or possess such qualifications as the Committee on Post-Graduate Studies of the General Faculty Council, after reference to the Science Committee of the Faculty of Arts and Science, may deem to be the equivalent of this degree. If his degree be the pass Bachelor of Science degree of the University of Manitoba he must have obtained a standing of at least 67 per cent in either the Third or the Fourth Year of his undergraduate course in the subject or subjects in which he proposes to elect work for the Master of Science degree.

2. (a) The candidate for the Master of Science degree who, on admission, possesses the Honors B.Sc. degree of the University of Manitoba or an equivalent degree must, to earn the Master's degree, complete at least one year of graduate work in one or more of the following departments of the University of Manitoba: Mathematics, Physics, Chemistry, Geology, Botany, Zoölogy, Physiology, Biochemistry. He shall complete and pass an examination on two courses of study, one closely related to the subject of his thesis and the other on an allied subject. His work shall be done under the direction of at least two members of the University Faculty of Arts and Science. The thesis and

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main course of study shall be taken in a department in which the student has completed the work of the Senior Division in his undergraduate course; the other may be taken in the same or an allied department.

(b) The candidate for the Master of Science degree who, on admission, possesses the Pass B.Sc. degree of the University of Manitoba or an equivalent degree, must, to earn the Master's degree, complete at least two years of work in two of the following departments of the University of Manitoba: Mathematics, Physics, Chemistry, Geology, Botany, Zoölogy, Physiology, Biochemistry.

He shall first obtain in ordinary course by attendance and examination sixteen units of credit in Honors Courses as prescribed for those proceeding to the Honors B.Sc. degree. Of these, eight units shall be for courses listed as Fifth Year Honor courses by the Department in which the candidate shall later elect to submit his thesis and of the remaining eight not more than four may be for courses under this Department. These sixteen units of credit, when completed, do not entitle the candidate to the Honors B.Sc. degree.

He shall then complete and pass an examination on two courses of study, one closely related to the subject of his thesis and the other on an allied subject. His work shall be done under the direction of at least two members of the University Faculty of Arts and Science. The thesis and main course of study shall be taken in a department in which the student has completed the work of the Senior Division in his undergraduate course and has studied during the First Year of his post-graduate course; the other may be taken in the same or an allied department. A total of 800 marks is assigned to the entire work for the M.Sc. degree, distributed as follows: 200 marks for the minor subject and 600 marks for the major subject and the thesis.

3. Every candidate for the Master of Science degree shall submit a thesis based on original work done under the direction of the department in which he has elected to do his research and this thesis must be found satisfactory by the candidate's examining committee.

4. A Bachelor of Science of the University of Manitoba may be permitted to meet the requirements for the Master of

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Science degree by courses of study taken in another University if such work be approved by the Committee on Post-Graduate Studies after reference to the Science Committee of the University Faculty of Arts and Science.

5. (a) Every applicant for admission as a candidate for the Master of Science degree should first consult with the heads of the departments of instruction in which he proposes to work and should arrange to submit through them, to the Committee on Post-Graduate Studies, for approval, not later than October 15th in any academic year, an outline of the courses he plans to undertake. When these have been approved he will be notified of the fact by the Secretary of the Committee on Post-Graduate Studies and must then become registered at once as a candidate for the degree and pay the required fees.

(b) The nature of the thesis shall subsequently receive the approval of the Committee on Post-Graduate Studies after reference to the Science Committee of the University Faculty of Arts and Science.

6. For the examination of the thesis of each candidate the examining committee shall consist of the instructors under whose direction the work has been performed and one other nominated by the Committee on Post-Graduate Studies. The pass-mark at written examinations for the M.Sc. degree is 60%; the thesis, to be satisfactory, must receive a grade of at least 67%.

7. The thesis in its completed form shall be submitted not later than the 15th of April in any year to ensure the conferring of the degree at the Annual Convocation of that year. At least four printed or typewritten copies of the thesis shall be submitted by the candidate. One of these will subsequently be deposited in the University Library. It is desirable that uniformity in style, format, etc., be observed and in reference to these matters the candidate should consult the Secretary of the Committee on Post-Graduate Studies.

Regulations for the Degree of Doctor of Philosophy (University of Manitoba)

No course leading to the degree of Doctor of Philosophy is announced in the Calendar, but the University has in recent years

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adopted a policy of accepting candidates for this degree who possess the necessary qualifications, and carry out work of suitable standard in a department adequately equipped for the purpose.

It was recognized that cases might arise in which the qualifications and previous training of the students and the standing of the research done in the University of Manitoba were of such a grade that, had the work been done elsewhere, it would undoubtedly have been deemed worthy of a Ph.D. degree. It was to obviate the unfairness of withholding the degree in such cases that it was made available under careful safeguards. Only graduates of other universities have so far been admitted to candidacy for this degree.

The tentative regulations (unpublished) for the degree resemble those of McGill and Toronto in requiring (1) three years' work after obtaining the honours bachelor's degree, of which one of the last two must be spent in the University of Manitoba, (2) a major and a minor subject, (3) a reading knowledge of two approved languages other than English, (4) a thesis. The major part of the work for the thesis must be done in the University of Manitoba. It is pointed out that the essence of a doctor's degree is the capability of doing good research work. To this end the thesis should constitute a distinct contribution to the advancement of knowledge and preferably, before submission, be published or accepted for publication in a reputable journal.

There are two special requirements for the doctorate at Manitoba not found among the regulations of McGill and Toronto:

(1) The candidate must spend at least one year of post-graduate work in another university approved by the Committee on Post-Graduate Studies. This is pointed out to be most essential, because obtaining a doctor's degree should involve the breadth of experience and outlook that such work would give.

(2) The committee of examiners should include two persons from outside the University. This requirement has so far been met by the heads of the departments in the Universities of Alberta and Saskatchewan, corresponding to the department in the University of Manitoba in which the candidate took his major work, reading the thesis and attending the oral examination.*

*The writer is informed that at McGill the thesis for the doctorate is read by at least one person from outside the University, though this is not stated in the regulations.

Graduate Courses at the University of Manitoba

There are no graduate courses offered in the Faculty of Agriculture (Manitoba Agricultural College). Neither are there courses in the Faculty of Arts and Science which are in the calendar specially designated for graduate students. The regulations for the Master of Science degree, however, require the student to complete and pass an examination on two courses of study, one closely related to the subject of his thesis and the other on an allied subject. These he should select from the courses listed in the calendar, in consultation with the heads of the departments concerned.

Special Research at the University of Manitoba

The distinguished researches on fungi, carried out in the Department of Botany by Professor A. H. R. Buller, F.R.S., have attracted many students, and continue to present excellent opportunities to agricultural graduates whose interests are in this field.

The Dominion Rust Research Laboratory, situated on the Agricultural College campus, is an important centre of investigations into the diseases of cereals, particularly stem rust of wheat. This makes a splendid contact for students of mycology or plant pathology.

The research work going forward in the Agricultural College, on bovine seminal pathology in the Department of Animal Pathology, and in cereal chemistry in the Department of Agricultural Chemistry, should provide good openings for graduate students as soon as graduate work is organized on the agricultural campus.

The Department of Agricultural Chemistry and the Department of Field Husbandry are coöperating in the grain research program which is sponsored and assisted in the Prairie Provinces by the National Research Council.

The University of Manitoba is also coöperating in the attack on cereal rusts and other diseases of field crops, sponsored jointly by the National Research Council and the Federal Department of Agriculture.

University of Saskatchewan

The College of Agriculture is on the same campus with, and an integral part of, the University of Saskatchewan. Graduate instruction in the University is carried only to the Master's degree, and is supervised by the Committee on Masters' Degrees. Inquiries should be addressed to the Registrar, University of Saskatchewan, Saskatoon.

Regulations for the Master's Degree

(From the University of Saskatchewan Calendar, 1929-30).

Work leading to Masters' degrees in Arts, Science, Agriculture or Engineering, may be undertaken by those who hold the corresponding Bachelors' degrees recognized by this University and who have obtained satisfactory standing in courses acceptable for this purpose. This work may be done in residence, or when the nature of the subjects permit, extra-murally. The time devoted to it must be at least one academic year in residence (one calendar year in the case of the M.S.A.) or at least two academic years in those cases in which it can be done extra-murally.

A course leading to the Master's degree must be taken in one of the groups of subjects, or in some one department, recognized for specialization in the undergraduate work, or in some group of departments specially authorized for the purpose. It must include at least a year's work in advance of the requirements for honours in a special undergraduate course, and the major part of it must be strictly graduate in character.

Examinations for the Masters' degrees shall be held at the time of the regular University examinations and at the option of the departments concerned, may be conducted by oral or written tests, or by means of a thesis on a subject approved in advance, or by both thesis and examination. As the Masters' course is an honour one the passing standard in the examination shall be as high as that for honours in a special undergraduate course.

Before entering upon a course those desiring to proceed to Masters' degrees should make application to the Registrar, giving the necessary information regarding their previous studies and

regarding the subjects in which they wish to work. These applications must be approved by the Committee on Masters' Degrees and confirmed by the University Council.

Graduate Courses at the University of Saskatchewan

It will be noted that in the regulations for the Master's degree there is no specific reference to course requirements. This matter and also the language requirement and examination requirement are left to the arrangement of individual departments. The usual plans followed in the Departments of Biology and Field Husbandry may be cited as examples.

The Department of Biology makes no definite course requirements (except that students in plant pathology must take the course in mycology), but requires the Bachelor's degree with honours standing as a prerequisite, and does not admit students to graduate status until the necessary courses have been taken. After this the degree is given for research work only, with no final examination. This Department requires a reading knowledge of German and recommends French also.

The Department of Field Husbandry requires, in addition to a thesis, one advanced course in field husbandry and two supporting courses in soils, biology, chemistry or economics. No language requirement is made, beyond the matriculation standing in one language other than English required for entrance to the University.

The courses available for graduate students are not specially designated in the calendar. Students should therefore consult in this regard the heads of departments in which they wish to work.

Special Research at the University of Saskatchewan

The researches on the cytology and genetics of wheat species hybrids, carried on in the Department of Biology, are well known, and have provided training for several graduate students. This work has lately been extended to the chromosomes of rye. The Department is also carrying on important investigations on cereal diseases, including rusts and foot-rots. In this work it has the coöperation of the associated Dominion Laboratory of Plant

Pathology, which is accommodated in the University. Thesis work done in the latter laboratory under suitable supervision and arrangements is accepted by the Department of Biology.

Both the Department of Biology and the Department of Field Husbandry are coöperating in the Dominion-wide attack on cereal rusts and other field crop diseases sponsored by the National Research Council and the Federal Department of Agriculture.

The investigations on forage crops, especially sweet clover, in the Department of Field Husbandry, are of a high order of merit.

Research in cereal chemistry is being pursued in the Department of Chemistry with assistance from the Saskatchewan Agricultural Research Foundation, and also coöperatively as one of the laboratories connected with the Associate Committee on Grain Research of the National Research Council.

The Department of Animal Husbandry has recently begun genetical studies of the number of ribs in bacon hogs, making the counts by X-ray photographs, and the relation of this to length of side and market value. This is an interesting and scientific attack upon an important practical problem.

University of Alberta

The College of Agriculture is on the same campus with, and an integral part of, the University of Alberta. Graduate instruction in the University is carried only to the Master's degree, and is supervised by the Committee on Graduate Studies. Inquiries should be addressed to the Chairman, Committee on Graduate Studies, University of Alberta, Edmonton.

The degree of Doctor of Science is also conferred by the University, but not for the completion of any prescribed course or amount of work. An application for this degree must be based wholly on original research, and the degree may be given if the work is adjudged to be of sufficient merit.

Regulations for the Master's Degree

(From the University of Alberta Calendar, 1929-30).

1. A candidate for the Degree of Master of Arts or Master of Science must possess a Bachelor's degree from this University or be admitted *ad eundem gradum*, and before presenting himself for the higher degree must have held the Bachelor's degree for at least one academic year.

2. An applicant for a graduate degree shall be admitted to candidacy for the degree in question only after any preliminary requirements have been performed to the satisfaction of the department or departments concerned and only after the applicant's complete programme has been approved by the Committee.

3. The Master's degree may be attained by following either of two methods: (a) the pursuit of a prescribed course of study or (b) the carrying out of an investigation. Regulations governing these two methods follow:

(a) *the pursuit of a prescribed course of study.*

(1) The candidate for the Master's degree must elect a major subject.

(2) The candidate shall arrange his entire course leading to the degree with the members of the department in which he chooses his major subject and the can-

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didate, having secured the department's approval, shall then submit his programme to the Committee on Graduate Studies for ratification.

- (3) If the candidate chooses also a minor subject, or if in the opinion of the department a minor subject should be added, representatives of the department of the minor subject shall act with the department of the major subject in arranging the candidate's course.
 - (4) The programme so arranged and recommended by the department or departments concerned for approval by the Committee on Graduate Studies shall consist of a substantial body of work covering not less than one academic year. While the equivalent of four graduate courses in addition to a thesis (see Clause 5) will constitute the working basis for this recommendation, each case shall be judged on its merits.
 - (5) In addition to completing satisfactorily the prescribed graduate courses, the candidate must prepare, under the direction of the members of the department of the major subject, a thesis, study, investigation, or piece of minor research. The granting of the degree shall be subject to the satisfactory completion of this requirement.
- (b) *the carrying out of an investigation.* A candidate who chooses to carry out a piece of original investigation shall submit on or before April 1st of the year in which the degree is to be taken, a formal report embodying the results of the investigation, or submit a dissertation indicative of acquaintance with the methods of research, which shall be printed or typewritten, in standard format, and which shall be deposited in the University Library. During the period of the student's candidacy, no use of the material or results of the investigation shall be made without the formal sanction of the Committee on Graduate Studies. In all cases the subject of the investigation must receive the written approval of the head of the

department concerned before it is submitted to the Committee on Graduate Studies as required in Section 4, and the report when completed shall be accepted only on the recommendation in writing of the department concerned. Every candidate will be required, in addition, to pass an examination, written or oral, on the subject within which his investigation lies. Such examination shall be conducted under the supervision of the Committee on Graduate Studies.

4. A candidate who is proceeding to the degree by method—
 - (a) Must submit the course of study which he proposes to follow to the Committee on Graduate Studies for its approval on or before the first day of November of the year in which he undertakes his work for the degree; or
 - (b) must submit the subject of the investigation he proposes to carry out, to the Committee on Graduate Studies, for its approval on or before the first day of November preceding the spring in which the degree is to be taken. Candidates are strongly recommended, however, to submit their applications to the Committee at the close of the preceding session. This is especially advisable for students wishing to work in scientific departments.

5. In respect of courses taken with a view to the fulfillment of the regulations for the Master's degree, the pass mark shall be 65%, and no supplemental examinations shall be permitted. The mark of 65% applies also to all essays required in connection with courses for the Master's degree.

Graduate Courses at the University of Alberta

It may be added by way of explanation of the regulations for the Master's degree, that only well-prepared students are permitted to follow Method (b), which bases the degree wholly upon investigation. Many students following Method (a), however, do not take four graduate courses, but, with the approval of their major department, replace one or more of these by additional research work, thus producing a more substantial thesis.

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There is no general language requirement, but the work in some departments makes a reading knowledge of French or German necessary.

Some departments designate in the calendar the courses available as graduate courses. More frequently they are labelled honours courses, and these are available both to senior honours students and to graduate students. Certain other senior courses not specially marked in the calendar are also authorized for the programmes of graduate students. Only the courses for graduate students offered by departments of the Faculty of Agriculture will be listed below. Courses in the cognate sciences are available in other faculties of the University. For these the University calendar may be consulted.

Animal Husbandry.

- Animal breeding.
- Herd-book studies and breed development.
- Animal nutrition.
- Economics of livestock production.
- Advanced animal production and nutrition.
- Experimental methods.

Entomology.

- Taxonomy and technique.
- Advanced taxonomy.

Field Crops.

- Crop production: principles and practice.
- Genetics.
- Principles and methods of plant breeding.
- Advanced field crops.
- Advanced genetics and cytology.
- Plant biochemistry.
- Plant pathology.
- Seminar.

Soils.

- Advanced fertility.
- Soil bacteriology.
- Plant food supplies.
- Seminar.

Special Research at the University of Alberta

The Department of Soils and the Department of Field Crops work in close coöperation and have an extensive programme of investigations in the general field of plant science. The former Department is studying particularly soil fertility, soil microbiology and plant nutrition and is carrying on intensive soil surveys. The Department of Field Crops is investigating factors affecting wheat quality; the nature of resistance to frost, drought and disease; field crop diseases, especially cereal foot-rots; the control of disease by plant breeding; the cytology of *Medicago* and *Agropyron* species; and other problems. Since much of the work is done by graduate assistants, this programme provides a basis for a considerable group of graduate students.

The foregoing programme is assisted by the National Research Council, which makes the University of Alberta a local centre for its assisted researches on crop production problems in the West.

The Dominion Laboratory of Plant Pathology is accommodated in the University, and works in close association with the Department of Field Crops. Its programme emphasizes also the cereal foot-rots. Research work done by graduate students in this laboratory under suitable arrangements is accepted by the University.

The investigations of soft pork production and of the effect of ultra-violet light and vitamine D on growth and mineral assimilation in hogs, in the Department of Animal Husbandry, are of special interest.

The Department of Bacteriology is coöperating in the Dominion-wide investigations of bovine tuberculosis, coördinated and assisted by the National Research Council.

University of British Columbia

The Faculty of Agriculture is an integral part of the University of British Columbia. Graduate instruction in the University is carried only to the Master's degree, and is supervised by the Faculty concerned. Inquiries may be addressed to the Registrar, University of British Columbia, Vancouver.

Regulations for the Degree of Master of Science in Agriculture (M.S.A.)

(From the University of British Columbia Calendar, 1928-29).

1. Candidates for the degree of Master of Science in Agriculture (M.S.A.) must hold a bachelor's degree from this University, or its equivalent.

2. A graduate of another university applying for permission to enter as a graduate student is required to submit with his application an official statement of his graduation together with a certificate of the standing gained in the several subjects of his course. The Faculty will determine the standing of such a student in this University. The fee for examination of certificates is \$2.00.

3. Candidates with approved degrees and academic records who proceed to the master's degree shall be required:

(a) To spend at least one year in resident graduate study; or

(b) (At the discretion of the Faculty concerned):

(i) To do two or more years of private work under the supervision of the University, such work to be equivalent to one year of graduate study; or

(ii) To do one year of private work under University supervision and one term of resident graduate study, the total of such work to be equivalent to one year of resident graduate study.

4. Students doing tutorial work shall not be allowed to come up for final examination in less than two academic years after registration as M.S.A. students.

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5. One major and one minor shall be required. Candidates may select their minor in another Faculty.
6. (a) A thesis must be prepared on some approved topic in the major subject.
(b) Examinations, written or oral, or both, shall be required.
7. Two typewritten copies of each thesis, on standard-sized thesis paper, shall be submitted.
8. Application for admission as a graduate student shall be made to the Registrar by October 15th.

Graduate Courses at the University of British Columbia

The Departments of Agronomy, Animal Husbandry, Dairying, Horticulture and Poultry Husbandry each list in the calendar one or two courses in "directed research", for graduate students. The Department of Agricultural Economics offers a graduate course in "the principles of economics as applied to agriculture", and another in "the general principles of marketing."

Apart from the foregoing, the courses which are available for graduate students are not specially designated in the calendar, but are selected in consultation with the departments concerned and with the approval of the candidate's committee. Work in the cognate sciences may be taken in any department of the University offering suitable courses. The relative amount of course work and thesis work is left to arrangement in individual cases. Normally, however, about one-third credit is assigned to the thesis and one-third each to major and minor courses. There is no definite language requirement.

Special Research at the University of British Columbia

The cheese-ripening studies carried on in the Department of Dairying are outstanding, and have recently been accorded support by the Empire Marketing Board. The project involves both bacteriological and biochemical studies.

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The Poultry Department is investigating the inheritance of egg size; also the vitamine value of fish oils and the protein value of fish meals, in poultry nutrition.

The Departments of Bacteriology and Poultry, with assistance from the National Research Council, are investigating the control of bacillary white diarrhoea in poultry by blood tests of breeding stock and destruction of infected birds.

The Departments of Animal Husbandry (including Veterinary Science), Bacteriology and Chemistry are coöperating in an institutional project for investigating blood normals in domestic animals and variations therefrom caused by various factors. The purpose is to aid in dealing with certain pathological conditions thought to have a nutritional basis. It is planned to extend the investigation through the fields of botany and geology, the latter because of its relation to soil type and the composition of fodder.

The Department of Agronomy is carrying on genetical investigations of alfalfa and cultivated grasses, and studies on the variation in morphological characters of soil organisms.

The Department of Economics is conducting farm surveys with the coöperation of other departments.

Among the interesting projects just being initiated are the investigation of range grasses and the relation of crop plants to environmental conditions such as soil moisture and temperature, in the Department of Agronomy; and of the factors affecting the growth of trees and of orchard cover crops, in the Department of Horticulture.

SCHOLARSHIPS AND FELLOWSHIPS

It is not the intention to give here a full list of all scholarships and fellowships which may possibly be available to agricultural graduates, but rather to direct attention to, and give brief notes concerning, those which are either intended more particularly for agricultural graduates, or which agricultural graduates have found available on equal terms with graduates of other faculties.

National Research Council Scholarships

The National Research Council of Canada offers annually a number of bursaries, studentships and fellowships to qualified graduates who will continue their training in some branch of science useful to the industries, including agriculture.

Bursaries of the value of \$750 are open to applicants who have graduated with high distinction in scientific study.

Studentships of the value of \$1,000 are open to applicants who have already done some original graduate research in science.

Fellowships of the value of \$1,200 are open to applicants who have given distinct evidence of capacity to conduct independent research in science.

These scholarships are open on equal terms to men and women who are British subjects resident in Canada, unmarried, and not over thirty-two years of age. A bursary or first studentship must be held in a Canadian university. A second studentship awarded to the same candidate may, by special approval of the Council, be held in a Canadian scientific laboratory or works.

A Ramsay Memorial Fellowship, tenable in Great Britain, and of the value of \$1,750 is open to award, through the National Research Council, to an applicant who has given distinct evidence of a high capacity for independent research in the science of chemistry. The winner of this fellowship is eligible for reappointment for a second year.

A limited number of travelling fellowships, similar to the Ramsay Memorial Fellowship, are open to award to students of

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outstanding research ability. Normally, the possession of a Ph.D. is a prerequisite for a travelling fellowship.

The Canadian Coöperative Wheat Producers, Limited, (The Wheat Pool), offer three fellowships with an annual value of \$1,200, tenable in the Universities of Alberta, Manitoba and Saskatchewan, open to qualified graduates of any Canadian University who desire to pursue advanced studies and research in problems connected with the grain-growing industry in the Prairie Provinces of Canada. These fellowships are given through the National Research Council, and are subject to the usual regulations of the Council.

Application blanks and circulars giving full information in regard to the foregoing scholarships and fellowships may be obtained from the registrar of any Canadian University, or from the Secretary, National Research Council, Ottawa. Applications are required to reach the Research Council not later than March 15.

The T. Eaton Company Scholarships

The T. Eaton Company, Limited, donates annually five scholarships of the value of \$600 each, which are open to graduates who are members of the Canadian Society of Technical Agriculturists, and tenable in any Canadian university. This is a broad-minded, public-spirited example, which it is to be hoped other corporations may follow.

The T. Eaton Company scholarships are awarded through a committee of the Canadian Society of Technical Agriculturists, which meets once a year at the time of the annual convention in June. Applications should be sent in well in advance of that date. Forms for application and full particulars may be obtained from the Secretary, Canadian Society of Technical Agriculturists, Ottawa.

The 1851 Exhibition Science Research Scholarships

The Royal Commission for the Exhibition of 1851 donates annually to Canada three scholarships of a value of £250 per annum for two, or in rare instances, three years, together with certain possible allowances for fees and travelling expenses. They

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are open to British subjects under twenty-six years of age who have been students of science for not less than three years. These scholarships have been awarded in a number of instances to agricultural graduates who have possessed the necessary qualifications and capacity for research.

Application must be made through the university of which the candidate is a graduate.

The Hudson's Bay Company Research Fellowship

This Fellowship of a value of \$1,500 is offered annually by the Hudson's Bay Company for research in pure or applied science. It is open to graduates of any Canadian university and tenable at the University of Manitoba. This fellowship has been held by agricultural graduates.

Applications must be in the hands of the Registrar, University of Manitoba, Winnipeg, not later than April 1st.

Provincial Scholarships and Fellowships

Several of the provinces have scholarships or fellowships open to local graduates and tenable in local universities. For information as to these, graduates should study carefully the calendars of their own institutions.

Special mention should be made, however, of the Open Fellowships of the University of Toronto. There are seven of these fellowships with an annual value of \$500 each, in addition to free tuition for one year. They may be renewed a second year, contingent on satisfactory progress. Preference is given to candidates who are graduates of Canadian universities outside Ontario. Applications should be addressed to the Dean of the School of Graduate Studies, University of Toronto, not later than May 1st.

DUE DATE

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